RESEARCH ARTICLE Asian Journal of Dairy and Food Research, Volume 44 Issue 6: 962-967 (December 2025)

Effect of Soaking, Roasting and Germination on Nutritional Quality and Colour Properties of Pearl Millet Flour

Aditi H. Bachate[1], Vijaya S. Pawar[1], Godawari S. Pawar[2], Shraddha M. Rodge[3], Monali M. Joshi[1]

10.18805/ajdfr.DR-2371

ABSTRACT

Background: Pearl millet (*Pennisetum glaucum*), plays a vital role in ensuring food security in arid regions, it is the sixth most cultivated cereal at global level. It is a significant source of energy and protein, often referred to as the "poor man's grain," as it is high in nutritional value. The present study focused on the effect of different pretreatments on nutritional, antinutritional and colour profile of pearl millet flour.

Methods: In present investigation, pearl millet grains were subjected to different processing treatments *viz*. soaking, roasting, germination and studied the post treatment effect on nutritional and colour profile of pearl millet flour. The influence of processing on proximate, mineral, anti-nutrient and colour value of pearl millet flour was studied.

Result: Results showed that processing treatments significantly affected the nutritional and colour profile of pearl millet flour with reference to untreated pearl millet flour. Proximate composition assessment of pearl millet flour revealed that roasting reduces the moisture content was reduced most (6.74%) while fat content was increased (5.80%). During germination protein, crude fiber, ash and carbohydrate was 13.29%, 2.40%, 2.09% and 71.44% respectively. Results for post treatment effects on nutritional profile of pearl millet flour remarked that germination as best in terms of nutritional and colour enhancement with anti-nutrients (Tannin and phytic acid) reduction than soaking and roasting.

Key words: Antinutritional, Colour, Pearl millet, Pretreatments, Proximate.

INTRODUCTION

In March 2021, the seventy-fifth session of the United Nations General Assembly declared 2023 the International Year of Millets (FAO-2023), following a proposal submitted by the Government of India supported by 72 countries. FAO-2023 mainly focused to increase awareness about benefits of millets, with their nutritional value, health advantages to environmental sustainability and economic potential. Year-2023 facilitated partnership, engaged stakeholders in millet production and promotion and boost public consumption of millets by enhancing collaboration between science and policy. Furthermore, FAO (2023) encouraged research and development for sustainable, resilient millet production by highlighting new market opportunities for farmers and producers and to produce innovative millet-based products for consumers (FAO, 2023).

Pearl millet (*Pennisetum glaucum*) and sorghum (*Sorghum bicolor*) are commonly grown crops in the dry and semi-dry region of Africa (Eltayeb *et al.*, 2007). These crops have not been utilised sufficiently and hence, considered underutilised crops even though it is rich in essential nutrients and nutraceutical compounds (Taylor and Duodu, 2015).

Pearl millet (*Pennisetum glaucum*), plays a vital role in ensuring food security in arid regions, it is the sixth most cultivated cereal at global level. It is a significant source of energy and protein, often referred to as the "poor man's grain," as it is high in nutritional value (FAO, 2013).

Pearl millet, an important coarse-grain cereal and forage crop cultivated in the arid and semi-arid regions of the Indian subcontinent and Africa, plays an important role in providing dietary energy and supporting nutritional security (Bhat *et al.*, 2018). Pearl millet is a good source of important minerals like potassium, calcium, sodium, magnesium and phosphorus. It is especially rich in iron and zinc, which can help to increase haemoglobin levels. Additionally, it contains antioxidants, especially phenolic compounds, which may have anti-cancer benefits (Huang *et al.*, 2020).

[1]Department of Food Process Technology, College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani-431 402, Maharashtra, India.
[2]Department of Agricultural Botany, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani-431 402, Maharashtra, India.
[3]College of Food Technology, Krishi Vigyan Sankul, Kashti, Malegaon, Mahatma Phule Krishi Vidyapeeth, Rahuri-42 3105, Maharashtra, India.
Corresponding Author: Aditi H. Bachate, Department of Food Process Technology, College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani-431 402, Maharashtra, India. Email: aditibachate23@gmail.com
ORCID: 0009-0000-0699-0656

How to cite this article: Bachate, A.H., Pawar, V.S., Pawar, G.S., Rodge, S.M. and Joshi, M.M. (2025). Effect of Soaking, Roasting and Germination on Nutritional Quality and Colour Properties of Pearl Millet Flour. *Asian Journal of Dairy and Food Research*. **44(6):** 962-967. doi: 10.18805/ajdfr.DR-2371.

Submitted: 04-07-2025 **Accepted:** 25-08-2025 **Online:** 20-09-2025

With the ongoing global issue of food insecurity, there is a growing need to make better use of existing crops to develop nutritious, affordable and attractive food products for people around the world. To meet this goal, various food processing methods are used to increase nutrient availability, enhance taste, texture and reduce anti-nutritional factors in the food (Nanje Gowda *et al.*, 2022).

For the development of off-odours in the flour during storage, the goitrogenic compounds in pearl millet are derivatives of phenolic flavonoids, such as C-glycosyl flavones and their metabolites are responsible (Taylor and Emmambux, 2008).

Antinutritional factors, that can bind to metals and inhibit enzymes and reduce the bioavailability of essential nutrients, particularly minerals and proteins. However, now a day, some of these compounds-especially polyphenols-have also been known for their health benefits as it including antioxidant properties (Rao *et al.*, 2017). Different pretreatment and processing methods are applied on food grains, such as de-branning, soaking, germination, fermentation and autoclaving, to reduce antinutrients. These processing methods improve the nutritional quality of food by increasing the bioavailability of minerals like calcium, iron and zinc, as well as enhancing protein absorption (Birania, 2020).

Pearl millet consists of a huge amount of inositol hexa-phosphates (IP6), commonly known as phytic acid or phytates. Phytates are considered antinutritional compounds as it reduces the body's ability to absorb important minerals like calcium, phosphorus, zinc, iron, copper and manganese as it binds with these minerals. Other antinutrients, such as tannins and polyphenols, also limit the grain's use as a food source. Reducing the level of phytic acid is important because it can improve the nutritional value of pearl millet. As a result, there has been growing interest in finding ways to lower its antinutritional effects (Mahajan and Chauhan, 1987).

Hence, this study aimed to evaluate the effect of pretreatments like soaking, roasting and germination on proximate, mineral, antinutritional factors and colour properties of pearl millet, so as to consider possible usage of pearl millet in different value-added product in food system.

MATERIALS AND METHODS

Materials

The present research work took place during year 2023-2025 at the "College of Food Technology, Vasantrao Naik Marathwada Krishi Vidyapeeth (VNMKV), Parbhani."

Pearl millet grains, purchased from local market of Parbhani, were cleaned to remove dust, sticks, straws and freed from foreign materials including broken. These grains were divided in two batches (1000 g each) used for further processing as each batch was then divided into four (250 g) portions for three pretreatments (soaking, roasting and germination) and one used as a raw sample.

Sample preparation and pretreatments

Untreated pearl millet flour

Pearl millet grains were cleaned first properly and milled through lab scale hammer mill to get fine flour of 40 mesh size. The untreated pearl millet flour was stored in polyethylene zipper plastic bag at room temperature.

Soaked pearl millet flour

Pearl millet grains were cleaned first properly, wash it for two to three times with tap water to remove dust, soaked in tap water (1:5) ratio (Khandelwal *et al.*, 2010a) for 12 hrs and dried in a tray drier at 65°C for 4 hrs. After drying cooled it to normal temperature and millet through lab scale hammer mill to get fine flour. The obtained flour was sieved using a 40-mesh sieve. The soaked pearl millet flour was stored in polyethylene zipper plastic bag at room temperature.

Roasted pearl millet flour

Pearl millet grains were cleaned first properly, roasted it in a pan at 80°C for 10 min. which change the colour of grain and produces the flavour, after roasting cooled it to normal temperature and millet through lab scale hammer mill to get fine flour. The obtained flour was sieved using a 40-mesh sieve. The roasted pearl millet flour was stored in polyethylene zipper plastic bag at room temperature (Kulthe *et al.*, 2022).

Germinated pearl millet flour

Pearl millet grains were cleaned first properly then wash it for two to three times with tap water to remove dust, soaked it for overnight 12 hrs in 1:5 ratio, after completion of soaking period the excess water was discarded. Soaked grains were tightly bound in a muslin cloth and frequently water was sprayed when needed in a 48 hrs of germination period. The sprouted grains were dried in a tray drier at 65°C for 4 hrs, rootlets were removed and then grains were milled in lab scale hammer mill to get fine flour. The obtained flour was sieved using a 40-mesh sieve. The germinated pearl millet was stored in polyethylene zipper plastic bag at room temperature (Sharma *et al.*, 2015).

Proximate composition

The proximate analysis of processed pearl millet flour samples was analyzed for moisture, crude fat, crude protein, crude fibre, ash content and carbohydrate content. The analysis was performed by using procedure outlined by (AOAC, 2005).

Mineral composition

Two gram of defatted processed pearl millet flour was weighed and burned at 550°C. The obtained ash was treated with concentrated hydrochloric acid (HCl) on hot plate for digestion. Then after digestion sample was filtered through Whatman No. 42 filter paper and made volume up to 100 mL using distilled water for mineral analysis by following standard process given by (AOAC, 2005) using

atomic absorption spectrophotometer (AAS Model: Varian, AA-240, Victoria, Australia) using air acetylene flame. Calcium, iron, magnesium, zinc was analyzed.

Antinutritional factor

Tannin and phytic acid analysis were carried out by method given by (Mane *et al.*, 2023). Tannin estimation, about 0.1 mL of sample extract was transferred to a 100 mL volumetric flask containing 75 mL of distilled water. Folin-Denis reagent (5 mL) and sodium carbonate solution (10 mL) were then added and the volume was adjusted to 100 mL with distilled water. The resulting solution was incubated for 30 min. and then the absorbance was recorded against an experimental blank at 760 nm.

For the phytate test, the powder sample (0.15 g) was combined with 10 mL of HCl (2.4%) and the extraction was performed using a shaking incubator (1 hr/25-27°C). The resulting solution was centrifuged (3000 rpm/30 min) and filtered to obtain a pure phytate extract. Briefly, 1 mL of Wade reagent (0.3% of sulfosalicyclic and 0.03% $FeCl_3$. $6H_2O$ acid in water) was mixed with sample extract (3 mL) and vortexed for 5 seconds. The reading was immediately recorded at a wavelength of 500 nm and the results reported as mg/100 g dry basis of sample weight.

Colour analysis

Colour of processed pearl millet flour evaluated through hunter lab calorimeter (Model No. Color Flex EZ). Hunter lab calorimeter was calibrated with white tile. Average L*, a* and b* values of processed pearl millet flour samples were reported and analysis was carried out in triplicate (Jyotsna *et al.*, 2015).

Statistical analysis

The data of all experimental treatments were statistically analysed by completely randomized design (CRD) using analysis of variance (ANOVA) (Panse and Shukhatame, 1985).

RESULTS AND DISCUSSION

Proximate composition

The effect different pretreatments like soaking, roasting and germination on proximate composition like moisture, crude fat, crude protein, crude fiber, ash and carbohydrate of pearl millet was resulted in Table 1.

Moisture content of pearl millet was found to be lower in pretreated pearl millet flour as compared with raw pearl millet flour, in soaked and germinated pearl millet flour moisture content was 9.40% and 8.60% as after giving pretreatments like soaking and germination millet grains were dried which might reduce the moisture content. More reduction occurred during roasting that is from raw 10.46% to 6.74% in roasted pearl millet flour it might be due to evaporating the water during heating. The moisture content of roasted pearl millet flour was reduced, it may be attributed due to the drying effect due to roasting (Komeine *et al.*, 2008).

Fat content of pearl millet flour in soaking pretreatment was 4.96%, roasting 5.80% and in germination 4.06%. The fat content of soaked pearl millet flour was found nearabout similar with raw pearl millet flour 5.04%. During roasting fat content was increased it could be due to reduction in moisture content as it will get concentrated, in germinated pearl millet flour it was reduced which might be occur due to during germination process grain use energy and fat content act as energy source which cause reduction in fat content in germinated pearl millet flour (Sade F.O. 2009).

Protein content found in soaked, roasted and germinated pearl millet flour was 12.10%, 11.20% and 13.29% respectively. During soaking and germination protein content was increased it might be due to the synthesis of new amino acids (Sharma *et al.*, 2015), while during roasting it was reduced. The decrease in protein content of roasted pearl millet flour might be due to alteration of structures of endogenous protein due to roasting (Fasasi, 2009). Crude fiber content was 2.11% in soaked, 1.90 in roasted and 2.40 in germinated millet flour. Ash content was 2.10% in soaked, 2.25% in roasted and 2.09% in germinated millet flour. Carbohydrate was high in roasted 72.11%, followed by germinated 71.44% and 69.33% in soaked pearl millet flour. Results were similar to (Kulthe *et al.*, 2022). While, in untreated pearl millet flour protein content was 11.40 %, crude fiber was 2.10 %, ash 2.10 % and carbohydrate was about 68.90 %, these findings were closely agreement with (Singh *et al.*, 2017; Mahalakshmi *et al.*, 2024).

Mineral composition

The mineral composition of processed pearl millet flour was given in Table 2. Effect of soaking, roasting and germination

Table 1: Effect of different pretreatments on proximate composition of pearl millet.

Nutrients (%)	Content (%)			
	Untreated pearl millet	Soaked pearl millet	Roasted pearl millet	Germinated pearl millet
Moisture	10.46±0.02	9.40±0.33	6.74±0.05	8.60±0.33
Crude fat	5.04±0.033	4.96±0.32	5.80±0.49	4.06±0.02
Crude protein	11.40±0.03	12.10±0.08	11.20±0.82	13.29±0.86
Crude fiber	2.10±0.40	2.11±0.33	1.90±0.40	2.40±0.35
Ash	2.10±0.16	2.10±0.27	2.25±0.13	2.09±0.029
Carbohydrate	68.90±0.14	69.33±0.01	72.11±1.63	71.44±2.44

*Each value is mean of three determinations.

on minerals like calcium, magnesium, iron and zinc was evaluated.

The calcium content of germinated pearl millet flour was found to be high 44.23 mg/100 g as compared with untreated pearl millet flour 40.68 mg/100 g. During soaking there was slight increase in calcium content 41.21 mg/100 g whereas low calcium content found in roasted pearl millet flour 38.75 mg/100 g. High temperature during roasting caused the more loss of calcium. Magnesium content was reduced in all pretreatments, during germination it reduced more 112.25 mg/100 g followed by soaking 122.00 mg/100 g and then roasting 124.00 mg/100 g it might be due to utilization during processing.

Iron and zinc content during soaking and germination get reduced, Iron during soaking 8.10 and germination 8.25 mg/100 g it might be due to leaching occurs during processing and in roasting it increased 11.20 mg/100 g it might be due to roasting was carried out in iron pan and heat may cause intact without leaching. Zinc showed similar results like iron. The obtained results with respect to minerals in pearl millet flours were more or less similar to earlier reports given in the literature. Decrease in mineral content of roasted pearl millet flour may be attributed to the application of heat which has the tendency to induce both nutritional and biochemical variation in food composition (Yarkwan and Uvir, 2014; Kulthe *et al.*, 2022; Sade, 2009).

Antinutritional factor

Anti-nutrients like phytic acid and tannins were analyzed for pearl millet flours (Table 3). Processing of pearl millet grains, *i.e.*, soaking, roasting and germination, caused decrease in phytic acid content 550 mg/100 g to 295 mg/100 g, 315 mg/100 g and 200 mg/100 g respectively and Tannin 430 mg/100 g to 157 mg/100 g, 160 mg/100 g and 137 mg/100 g respectively. Variation in phytic acid, tannins and polyphenol content among treated pearl millet flours can be attributed to flour type, extraction rate and both genetic and environmental conditions. Kheterpaul and Chauhan, (1991) reported phytic acid content of pearl millet with a value of 990 mg/100 g, Kumar and Chauhan (1993) reported phytic acid value of 825.7 mg/100 g. Tannins and phytic acid compounds reduces the digestibility of proteins, carbohydrates and minerals as it binds with nutritional component (Linda and Rooney, 2006).

Colour analysis

The colour of the grains and flour was reported in terms of three components *viz*., colour L*, colour a* and colour b*. L* indicates lightness and the colour intensity for L* varies from 0 (black) to 100 (white) and a* positive value denotes redness; negative value denotes greenness and b* denotes yellowness by positive value and blueness by negative value. The colour of pearl millet grain and pretreated pearl millet flour was analysed and L*, a*, b* values are shown in Table 4.

L*, a*, b* value of pearl millet grain was 64.62, 3.23 and 8.68 respectively. L* value was increased in flour form than whole grain colour. L* value of untreated pearl millet flour was 66.73, soaked pearl millet flour 69.96 and germinated pearl millet flour 72.19 while it decreased in

Table 2: Effect of different pretreatment on mineral composition of pearl millet.

Minerals	Content (mg/100 g)			
	Untreated pearl Millet	Soaked pearl millet	Roasted pearl millet	Germinated pearl millet
Calcium	40.68±1.66	41.21±0.98	38.75±0.25	44.23±0.06
Magnesium	130±7.35	122±6.53	124±3.26	112.25±0.84
Iron	8.32±0.02	8.10±0.21	11.20±0.22	8.25±0.01
Zinc	3.1±0.82	3.04±0.85	3.20±0.57	3.05±0.81

*Each value is mean of three determinations.

Table 3: Effect of different pretreatment on Antinutritional factor of pearl millet.

	Untreated	Soaked	Roasting	Germinated
Tannin	430±4.08	157±0.82	160±2.05	137±0.41
Phytic acid	550±0.86	295±2.45	315±3.26	200±0.94

*Each value is mean of three determinations.

Table 4: Effect of different pretreatment on colour value of pearl millet.

Millet	L*	a*	b*
Pearl millet grain	64.62±0.01	3.23±0.02	8.68±0.025
Untreated pearl millet grain flour	66.73±0.04	1.19±0.05	13.79±0.023
Soaked pearl millet flour	69.96±0.06	1.33±0.04	12.86±0.028
Roasted pearl millet flour	65.60±0.08	3.13±0.01	13.11±0.030
Germinated pearl millet flour	72.19±0.01	1.18±0.07	12.12±0.04

*Each value is mean of three determinations.

roasting 65.60 as during roasting the colour was changed due to Millard reaction (Ibanoglu, 2002); while during soaking and germination L* value was increased, it might be due to leaching of colouring compound in water. In colour of grain, in seed form colour basically represented the colour of seed coat while colour of flour is the mixed effect of colour of all component of grain (Mridula *et al.*, 2008). The a* value of untreated pearl millet flour, soaked pearl millet flour, roasted pearl millet flour and germinated pearl millet flour was 1.19, 1.33, 3.13 and 1.18 respectively. The b* value was 13.79, 12.86, 13.11 and 12.12 of untreated, soaked, roasted and germinated pearl millet flour respectively. Similar results were given by (Gaurav *et al.,* 2021) and (Mercy and Kiruba, 2021).

CONCLUSION

The results obtained in the study showed that preprocessing treatments had a good impact on the nutritional compositions, minerals and colour attributes of pearl millet. It can also helpful for reduction of antinutritional factors which increases the bioavailability of nutrients. Soaking, roasting and germination of pearl millet helps to reduce antinutritional factors Among all pretreatment's germination was found the best as it enhances the nutritional profile of pearl millet.

ACKNOWLEDGEMENT

Authors are thankful to Dr. V. S. Pawar Research guide for constant encouragement and support.

Disclaimers

The views and opinions expressed in this paper is of author. The author is solely responsible for content and accuracy.

Conflict of interest

The authors declare that there are no conflicts of interest.

REFERENCES

AOAC. (2005). Official Methods of Analysis. Association of Official Analytical Chemists, Washington D.C.

Bhat, S., Nandini, C., Tippeswamy, V., Prabhakar (2018). Significance of small millets in nutrition and health- A review. *Asian Journal of Dairy and Food Research*. **37(1):** 35-40. doi: 10.18805/ajdfr.DR-1306.

Birania, S., Rohilla, P., Kumar, R., Kumar, N. (2020). Post harvest processing of millets: A review on value added products. *Int. J. Chem. Stud.* **8:** 1824-1829.

Eltayeb, M.M., Hassan, A.B., Sulieman, M.A. and Babiker, E.E. (2007). Effect of processing followed by fermentation on anti-nutritional factors content of pearl millet (*Pennisetum glaucum* L.) cultivars. *Pakistan Journal of Nutrition*. **65:** 463-467.

FAO (2013). The state of food insecurity in the world: food systems for better nutrition. Food and Agriculture Organization.

FAO. (2023). Unleashing the potential of millets - International Year of Millets 2023. Background paper. Rome. https://doi.org/10.4060/cc7484en.

Fasasi, O.S. (2009). Proximate, antinutritional factors and functional properties of processed pearl millet (*Pennisetum glaucum*). *Journal of Food Technology*. **7:** 92-97.

Gaurav, A., Pradhan, R.C. and Mishra, S. (2021). Comparative study of physical properties of whole and hulled minor millets for equipment designing. *Journal of Scientific and Industrial Research*. **80:** 658-667.

Huang, M.T., Ho, C.T. and Lee, C.Y. (2020). Phenolic Compounds in Food and Their Effects on. *Health II ACS Symposium Series*. **12:** 8. https://pubs.acs.org/sharingguidelines.

Ibanoglu, E. (2002). Kinetic study on color changes in wgeat germ due to heat. *Journal of Food Engineering*. **52:** 209-213.

Jyotsna, R., Milind, A., Inamdar, A., Sakhare, S. and Venkateswara Rao, G. (2015). Roller milled black gram (*Phaseolus mungo*) semolina and its influence on the quality characteristics of high protein pasta. *Journal of Food Science Technology*. **52(4):** 2464-2468.

Khandelwal, S., Udipi, S.A. and Ghugre, P. (2010a). Polyphenols and tannins in Indian pulses: Effect of soaking, germination and pressure cooking. *Food Research International*. **43(2):** 526-530. https://doi.org/10.1016/j.foodres.2009.09.036.

Kheterpaul, N. and Chauhan, B.M. (1991). Effect of natural fermentation on phytate and polyphenolic content and *in vitro* digestibility of starch and protein of pearl millet *(P. typhodeum*). *Journal of Science, Food and Agriculture*. **55:** 189-195.

Komeine, K.M., Nantaga, Seetharaman, K., Henriette, L., Kock, D. and Taylor, J.R.N. (2008). Thermal treatments to partially pre-cook and improve the shelf life of whole pearl millet flour. *Journal of Science, Food and Agriculture*. **88:** 1892-1899.

Kulthe, A.A., Khapre, A.P. and Rana, K. (2022). Processing driven impact on functional and nutritional profile of pearl millet. *Asian Journal of Dairy and Food Research*. **44(2):** 268-272. doi: 10.18805/ajdfr.DR-1997.

Kumar, A. and Chauhan, B.M. (1993). Effects of phytic acid on protein digestibility (*in vitro*) and HCI-extractability of minerals in pearl millet sprouts. *Cereal Chemistry*. **70:** 504-506.

Linda, D. and Rooney, L.W. (2006). Sorghum and millet phenols and antioxidants. *Journal of Cereal Science*. **44:** 236-251.

Mahajan, S. and Chauhan, B.M. (1987). Phytic acid and extractable phosphorus of pearl millet as affected by natural lactic acid fermentation. *Journal of Science and Food Agriculture*. **41:** 381-386.

Mahalakshmi, S., Malavika, S., Sindhuja, T.R. and Lakshmy Priya, K. (2024). Pearl Millet: Potential nutraceutical properties of pearl millet and its utilization in various food products: A review. *Bhartiya Krishi Anusandhan Patrika*. **39(1):** 46-50. doi: 10.18805/BKAP432.

Mane, R.P., Kshirsagar, R.B., Agarkar, B.S., Patil, B.M. and Katke, S.D. (2023). Effects of germination on antinutritional, colour, functional and physicochemical properties of millets. *The Pharma Innovation Journal*. **12(1):** 350-355.

Mercy, N. and Kiruba, K. (2021). Physical and functional properties of ancient grains and flours and their potential contribution to sustainable food processing. *International Journal of Food Properties*. **24(1):** 1529-1547.

Mridula, D., Goyal, R.K. and Manikantam, M.R. (2008). Effect of roasting on texture, colour and acceptability of pearl millet (*Pennsetum glaucum*) for making sattu. *International Journal of Agriculture Research.* **3(1):** 61:68.

Nanje Gowda, N.A., Siliveru, K., Vara Prasad, P.V., Bhatt, Y., Netravati, B.P. and Gurikar, C. (2022). Modern processing of Indian Millets: A perspective on changes in nutritional properties. *Foods.* **11(4):** 1-18. https://doi.org/10.3390/foods11040499

Panse, V.S. and Sukhatme, P.V. (1985). Statistical Method for Agricultural Workers. ICAR, New Delhi.

Rao, D.B., Malleshi, N.G., Annor, G.A., Patil, J.V. (2017). Nutritional and health benefits of millets. In Millets Value Chain for Nutritional Security: A Replicable Success Model from India; Indian Institute of Millets Research (IIMR): Hyderabad, India. pp. 112.

Sade, F.O. (2009). Proximate, antinutritional factors and functional properties of processed pearl millet. *Journal of Food Technology*. **7(3):** 92-97.

Sharma, S. Saxena, D.C. Riar, C.S. (2015). Antioxidant activity, total phenolics, flavonoids and antinutritional characteristics of germinated foxtail millet (*Setaria italica*). *Cogent Food Agric*. **1:** 1081728.

Singh, A., Gupta, S., Kaur, R. Gupta and H.R. (2017). Process optimization for anti-nutrient minimization of millets. *Asian Journal of Dairy and Food Research*. **36(4):** 322-326. doi: 10.18805/ajdfr.DR-1215.

Taylor, J.R.N. and Duodu, K.G. (2015). Effects of processing sorghum and millets on their phenolic phytochemicals and the implications of this to the health-enhancing properties of sorghum and millet food and beverage products. *Journal of Science and Food Agriculture*. **95:** 225-237.

Taylor, J.R.N., Emmambux, M.N. (2008). Gluten-free foods and beverages from millets. In Gluten-Free Cereal Products and Beverages; Academic Press: Cambridge, MA, USA. pp. 119-148.

Yarkwan, B. and Uvir, R.H. (2014). Effects of drying methods on the nutritional composition of unripe plantain flour. *Food Science and Quality Management*. **41:** 5-10.